ONTARIO DEPARTMENT OF AGRICULTURE.

ROAD BULLETIN

No. 2.

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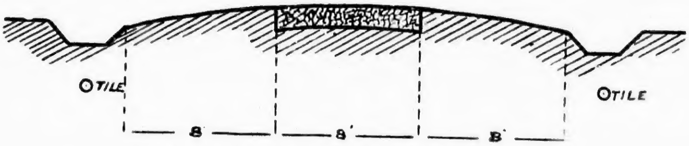

CROSS SECTION OF COUNTRY ROAD.
Common field tile underneath open ditches. Gravel or broken-stone roadbed, eight feet wide.

TORONTO, October 15, 1896.

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ROAD BULLETIN

No. 2.

ROAD LABOR AND EXPENDITURE IN ONTARIO.

The greater portion of road mileage in Ontario is constructed and maintained under the statute labor law. The statute labor is usually supplemented in each township by grants from the general funds of the municipality for grading, draining, purchasing gravel and road material, building bridges, culverts, etc. Any person required to perform statute labor may commute his time at the rate of one dollar per day. The amount of such commutation is paid either to the pathmaster or is collected with the general taxes of the municipality. A few townships have a by-law whereby statute labor must be commuted wholly or in part, but in such cases the rate is usually much less than one dollar, being in one instance as low as thirty-five cents.

While it is universally admitted that a great deal has been done by the pioneers of this country who performed their road work honestly and with zeal, there is a growing opinion in many parts of the Province that the statute labor system has survived its usefulness, that it is frequently wasteful and unjust. This feeling must necessarily grow wherever councils fail to secure an honest and systematic administration of the law.

Wherever the statute labor law has grown unpopular it will be found that the council gives little attention to the appointing of pathmasters, as to whether those chosen are the best suited to fill the position, but make such appointments as will hand the "job" around so that each property owner may do a little work in front of his own farm; the council exercises no supervision over the work while it is being performed, nor before nor afterwards; a pathmaster is appointed for about every mile of road in the township; pathmasters are retained in office too short a time to gain any experience or knowledge of road-making; the work done does not follow any definite plan, each pathmaster being left to his own resources; the work of one pathmaster is rendered useless or is torn up by the pathmaster succeeding to the office; the amount of money and labor at the disposal of each pathmaster is too limited to permit his undertaking any durable work; the pathmaster calls out at one time all whose names appear on the list, and sometimes they all respond and sometimes two or three put in their appearance; in the former case there may be so many men that it is impossible to direct them and they are in one another's way, while in the latter case, when several weeks afterward, they turn out to do their road work they do a little grading or haul a little gravel as the pathmaster directs and succeed in putting in time; the pathmaster seldom exercises sufficient forethought regarding implements and teams, and in consequence there are men and no teams, plows and no scrapers, or scrapers and no plows, wagon-boxes to hold a third of a cord, and wagon-boxes to hold a third of a yard; in general there is no plan of doing work and no organization whatever. For these reasons the people have lost interest in the road work; perhaps they find, too, that though one man may do his work faithfully, his neighbor merely tries to put in time; or though one section is sufficiently enterprising to put their roads in good condition, those adjoining are totally neglected.

In the majority of townships there are some good pathmasters who are doing good work, but the statute labor system in order to work satisfactorily and successfully, as a whole, requires as much or more attention than any other department of municipal affairs, generally, however, receiving less. The statute labor system should be reduced to a business basis; it must have organization and system, without which no enterprise, public or private, can be carried on with success. Road improvement should be carried on under the supervision of the council, or of a man or men appointed by them to do this work for them; the work done should be according to some uniform plan, having in view the improvement of all roads in the municipality; the number of pathmasters should be reduced to a degree that will permit each to have a sufficient amount of labor and money at his disposal to do permanent work; each pathmaster should see that sufficient men, properly provided with tools and implements, turn out when required, and not more or less than this number at any one time; pathmasters should be men who are respected, who will create enthusiasm in the work, men whose orders will be obeyed; they should be kept in office so that their experience, increasing knowledge and methods may be of advantage to the township, and the post of the pathmaster should be the most desirable within the gift of the municipality; any plan adopted should include the work of succeeding years as frequent change of plans will result in scattered, disconnected efforts; interest in road work must be stimulated so that every man, in doing his day's work, will make it equal to the dollar for which he might commute it. There must be progress, enthusiasm, union and system.

Very rarely is money appropriated and applied to road improvement under an economical system. Ditches are dug without providing outlets; gravel is applied without forming the roadbed; roads are gravelled without having been drained, then draining is undertaken and the gravel covered with the excavated earth, when the gravelling must be repeated; there is no discrimination between good gravel and material composed chiefly of sand; temporary sluiceways are built; work is done without proper machinery and the principles of roadmaking are ignored. As with the labor, there should be greater concentration of funds and careful supervision, while work meriting expenditure should be performed in a permanent and durable manner. It is to be carefully borne in mind that the purpose of this bulletin is not to suggest or to encourage an increased expenditure of money upon roads but to advise a more economical and satisfactory expenditure of the regular grants of councils; and in regard to statute labor, it is not proposed to increase the work or to bring in extra or outside workers but to advise a more profitable and permanent and satisfactory distribution and application of the labor now available for road improvement.

A number of townships have a by-law whereby any amount of money or labor voluntarily subscribed by the people of any section for the improving of roads is supplemented by an equal grant from the township funds. This is in a measure the Local Improvement By-law applied to rural districts. Its operation is notably successful in the township of Ekfrid, Middlesex County, and it is most interesting in so far as it shows what the people will and can do when the value of good roads has been practically demonstrated, when the result of road expenditure and labor is seen and felt, when progress is being made with sufficent rapidity to give encouragement and create enthusiasm. A healthy rivalry has been created under this simple and effectual mode of road construction and at the present rate of improving the roads of that municipality every highway in the township will be nicely gravelled in a very few years. Not only is the construction of roads taken into consideration in this township, but on some of the roads the system includes maintenance, a man being specially employed to fill wheel tracks, ruts and hollows and to keep drains clear of obstruction.

ROAD DRAINAGE.

The most frequent cause of bad roads in Ontario is lack of drainage. When a road is good during the summer months but scarcely passable in spring and fall the plain inference is that, if it could be kept dry it would be good the whole of the year. In a couple of months of spring and fall, roads, otherwise good roads, because of insufficient drainage, are destroyed more than in all of the remaining ten months of the year. Because of neglect in the simple matter, road labor and expenditure is very largely wasted. No farmer or business man can conduct his personal affairs in such a manner without failure.

Excavations called "drains" are, it is true, made at the side of the road but frequently are not provided with outlets, or the outlets are allowed to speedily fill up. From these receptacles, water soaks into and softens the foundation of the road. Loose dirt from this "drain" is piled in the centre of the road. This is soon roughened and tracked so as to hold water on the surface until it penetrates into the roadbed; producing pitch-holes—and actions against the municipality for damages. Under-drainage is seldom thought of to carry the water away from the foundation. The object of our roadmakers appears to be to cover the water with gravel or crushed stone, a tedious and costly process. A road must have a firm foundation obtained by drainage, since it is the natural soil which must support not merely the road metal but the traffic also. Strength in a roadbed must be had not so much in the road covering as in the natural soil beneath it.

Under-drainage is as necessary as surface drainage. A dry foundation is more necessary than a dry surface. Under-drains are needed not so much to carry away the water which falls on the surface of the road as to interrupt the water rising in the saturated earth from the impenetrable stratas beneath, "to lower the water line." Common field tile should be used three or four inches in diameter, hard, well-burned, and unwarped, every care being taken to lay it in the trench with a constant fall to a free outlet. Usually it is best to lay two tile drains, one on each side of the road, about two and a half or three feet below the bottom of the open drains. Thus placed they may be used as outlets for the surface drains if better cannot be obtained, proper catch-basins being provided. Lay the tile to an even and uniform grade and make the joints close. It is a good practice to cover the joint with sod, grass side down. A coating of straw is good in quick or running sand, but it is much better to completely surround the tile with sawdust.

A perfect system of drainage is obtained by surface and tile drainage. The surface of the road must be sufficiently rounded or crowned in the centre to shed the water readily to the side ditches or gutters. The water in its course to the gutters must not be impeded or held by hollows, tracks or ruts in the roadway. The gutters must be carried to a free outlet as often as possible having a good fall.

It is bad practice to carry water long distances and pour it over hills by the road side. Deep and dangerous gulches are thus created. This water before reaching the hill should, if possible, be carried through adjoining property to an outlet. Roads along sidehills should have a tile drain and an open gutter along the inner side of the roadway, and the trench containing the tile should be filled with gravel, broken stone, or other porous material to intercept the soakage water from the uplying land. On hills the course of the water may be arrested in the open drains at short intervals and caused to enter the tile through catch-basins, thus over-covering the wash of excessive and rapid flows of surface water. The traffic of winter often forms a channel for the water in the centre of the road, and in the spring before frost leaves the surface of the road the pathmaster should examine every hill and see that the gutters are free from obstruction of snow and ice. If this is neglected, constant and expensive repairs will be necessary.

Water in "springy" places on a roadbed should be conducted by drains from the centre of the road diagonally to the side under-drains. Springy places on a hillside embankment should also be tapped by a blind drain, and the water led quickly to the tile drains.

Take the water out and keep the water out.

Forming a Roadbed.

In making a road the grading and draining should be carried on during the same season, first the draining, then the grading. A road which is graded only, and then subjected to the traffic of fall and spring before draining is undertaken, is generally a shapeless mass by the ensuing summer, and a large amount of grading must necessarily be repeated. A road should also be drained and brought to the grade which it is to retain permanently before the road metal (gravel or crushed stone) is placed on it. Metal placed on an undrained roadway is so mixed with mud in the spring and fall as to be almost wasted. The natural soil under the gravel must be sufficiently firm to sustain not only the gravel, but the weight of traffic upon the gravel. No soil will do this unless it is sufficiently drained.

The roadway must be crowned, or rounded up towards the centre, to shed the water from the surface; the surface must be kept smooth and free from tracks, and it is as much the duty of gravel or crushed stone placed on a road to form a smooth, hard surface that will permit the water to flow readily off from it, as it is to form a durable covering to resist the wear of wheels.

The centre of the road should be excavated to receive the gravel or crushed stone. Where this care cannot be taken the metal may be placed on the centre and the sides graded up. The crown of the road should be obtained chiefly by rounding up the natural soil, but the metal should be several inches deeper in the centre than at the sides. On country roads, a crown of one inch rise to one foot of width from the side to the centre is generally sufficient; on hills it may be greater so as to prevent the water following the wheel tracks and deepening them to ruts.

The width of a roadway to be metalled depends upon the amount of traffic it will be required to accommodate. Eight feet will be ample for the majority of roads in rural districts. Roads forming the approach to towns may sometimes be metalled to a width of sixteen feet. The depth of metalling need never exceed after consolidation twelve inches, if of a good quality and clean, and eight inches is the least which should ever be employed, the thickness varying with the amount of traffic. It should be placed on in layers, and each layer thoroughly rolled, the subsoil having first been well consolidated.

After the work of forming the roadbed has been completed, a great deal may be done toward levelling the sides, seeding, planting trees, etc., and not until the road allowance between the fences is brought to a right condition, should the road be considered finished. No investment offers better returns than the building of good roads.

ROAD METAL.

The best road metal is that which is hard, tough, and not affected by the weather. For the lighter traffic of country roads, gravel or stone from local sources must generally be employed, as the cost of transportation will, at the present stage of roadmaking in Ontario, preclude the use of more durable stone from a distance. For heavier traffic in or near large towns the best material at almost any price is the most economical, as the decreased cost of maintaining a good metal (under heavy traffic) quickly makes up for the greater original cost of construction.

In this Province the roads may be roughly classed as (1) dirt, (2) gravel and (3) crushed stone (or macadam). Dirt roads give the least satisfaction, and are usually almost impassable for several months of the year. By greater attention to the drainage, however, their condition might be vastly improved. Roads of a very light sand may be improved by placing on them a coating of clay; and stiff clay roads are improved by a coating of sand. These means should be adopted only where gravel or crushed stone are not available. This treatment of clay and sand, however, is beneficial as a foundation for either gravel or stone.

Gravel should be screened so as to remove all stones over two and one-half inches in diameter, and all sand and earthy matter. Any material over two and one-half inches and under four inches may be used as a foundation layer upon which to place the finer material. Stones over four inches in diameter should be broken. If the township has in its employ a rock-crusher with screen attachment, it can be used to excellent advantage by placing it in the pit and putting all the gravel through it. By this means the dirt and sand are removed, the stones are coursed according to size, and those which need it are broken, all by the one operation. River or lake gravel is generally better than pit gravel on account of its freedom from dirt. Clean material is absolutely necessary in forming a durable roadbed.

Broken stone is beyond question very much better than gravel. The hardest and toughest is the best since it forms a more durable surface, diminishes the resistance of loads upon it and is more cheaply maintained. Limestone is the most common stone in the settled portions of Ontario. It varies in quality from that which is almost useless to that which in point of economy cannot be surpassed. What is lacking in durability is largely made up by its binding characteristics. But some limestone of doubtful quality, which is porous or slaty, decaying readily on exposure to the atmosphere, moisture or frost, should be used with caution. Some idea of the wearing qualities of rock can be had by performing a few simple tests: wearing on a grindstone, breaking with a hammer, scratching with a nail, compressing in a blacksmith's vice, etc. By comparing the results of these tests on different stones a fair opinion can be reached, but no test is conclusive except actual wear on the road.

Sandstone is obtainable in some parts of the Province, but as it readily crumbles and wears to sand, should be used only for lighter traffic on country roads. Granite is frequently of inferior quality, and, like the sandstone, readily crumbles under wear from the brittleness of the felspar which it contains; and gneiss, of which there is an abundance in northern Ontario, is no better.

Trap rock occurs in the vicinity of Kingston and Gananoque, and it is also imported by American cities from Poole Island in the northern part of Lake Superior. This is an exceedingly durable stone, and should be employed where traffic demands a more expensive pavement than that which can be obtained from local sources.

In many parts of the Province the fields by the roadside are almost covered with boulders and stones, there, apparently, for no other purpose than to be carried by the landowner to the road and converted by the use of a portable crusher into road metal. Boulders, though not equal to bed rock for macadam, makes a good road metal, and should by all means be preferred to gravel for strength and durability. Care should be taken, however, to discard boulders of sandstone, granite and limestone which have become impoverished or "weathered" by exposure to the atmosphere.

Absolute cleanliness of material is necessary in building gravel or macadam roads. No "binder" is needed when limestone, sandstone, gravel or the softer and less durable metals are used. Very hard granites and traps, however, need some aid to consolidation, but usually the best binder to use is the "screenings" of these materials. Sand is hurtful to the road when mixed with gravel or broken stone to act as a binder, and clay is infinitely worse.

ROLLING.

Rolling a road is especially beneficial in three ways: (1) By affording better surface drainage. (2) By making a more durable road. (3) By making the road at once fit for travel.

A road should be so smooth and compact on the surface as to shed the water readily to the side gutters. If the gravel or other road metal is dropped from the wagon loosely on a soft earth foundation, water is at once absorbed. Wheels passing over the road when in such a condition at once sink into and rut not only the gravel, but the earth beneath. Water is held in the ruts and each succeeding vehicle renders their condition worse.

The road is less durable, since the gravel, being mixed with the dirt beneath, obtains, when finally consolidated, a dusty, easily worn surface, rough in dry weather and muddy in wet, and its life is very much shortened.

The loose material placed on the road at midsummer is avoided by vehicles until forced by autumn rains to leave the dirt side road.

Not only is such a driveway useless for supporting heavy loads, but, it is needless to say, is very disagreeable for light travel. For a portion of the year, in fall and spring, the farming community of the Province is practically cut off from the markets, from business and social life; needlessly so, for the roads are during this period destroyed to such an extent as to render their more careful construction a most profitable investment. Badly built roads are always expensive to maintain. Two years' statute labor and road expenditure are laid out, when with proper tools for doing the work and with proper methods one should suffice.

Road rollers are not for city streets only. Wherever roads are made rollers should be used. Dirt, gravel and macadam roads are all benefited by rolling. When the best material is used there is more need, of course, that every precaution should be taken for its preservation.

The weight of roller used must depend upon various circumstances—the amount of work it will be required to do, the quantity of road metal used, the strength of the bridges and culverts over which it must pass.

A steam roller costs much more than a horse roller, but when it can be kept constantly employed does so much better and faster work that it is the more economical. For this reason when several municipalities can join together in the purchase of a steam roller it should be had. A weight of ten tons does satisfactory work, and is not too heavy for the majority of bridges.

Gravel and limestone bind more easily than the better varieties of granite and trap, and a lighter roller may be used with good effect.

If the bridges are old-time wooden structures, if the road mileage on which work is to be done is not very great, if the material used is not trap or similarly hard metal, a horse roller of from five to eight tons may be used. The work of a horse roller, however, is not so perfect as that of a steam roller. The feet of the horses disturb the metal, and the lesser weight requires that the rolling shall be continued very much longer.

Rolling should commence at the side of the road, approaching the centre gradually. If the roller is first passed over the centre, the loose metal is crowded out and the shape of the crown destroyed. It is best to roll the earth foundation in dry weather, and each succeeding layer up to the top dressing. When the latter is put on, the rolling should be continued in wet weather, or the metal thoroughly soaked with an ordinary watering cart. When finished the road should be thoroughly compact and solid, able to resist without displacement the heaviest load passing over it. Extra labor and expense in the first construction of gravel or macadam roads is more than made up by the decreased cost of maintenance. Bad roads are expensive.

TIRES.

It is not only necessary to make good roads; it is also necessary that they shall remain good. For this reason all European countries advanced in road-making, have laws regulating the width of tires used on wagons, carts and vehicles for heavy draught.

In France the width of tires ranges from three to ten inches, usually from four to six. Every market wagon and tonnage wagon is a roller; the forward axle is about fourteen inches shorter than the rear axle, so that the hind wheels run in a line about an inch outside the level rolled by the fore wheel.

In Germany, wagons used for drawing earth, brick, stone and similarly heavy loads must have a width of tire at least four inches.

In Austria all wagons built to carry a load of more than two and one-quarter tons must have tires at least four and one-third inches in width. In lower Austria a rim of four and one-half inches is required for wagons drawn by two horses.

In the State of Michigan persons using wide tires receive a rebate of one-fourth their road tax. The States of New York, California, Ohio, Indiana, Kentucky, Vermont, Pennsylvania, Massachusetts, Connecticut have laws pertaining to the width of tires.

Experience goes to show that broad tires are very much to be preferred for drawing loads through fields and on farm roads, as they sink less deeply into the soft earth and employ less draught to move them. On rough, rutted roads, the advantage is slightly in favor of the narrow tire in point of draught, but when wide tires are used by all there will be no rutted roads. One farmer using tires as narrow as four inches says that in the spring time he has only to drive up and down his lane a few times to change it into a smooth, level driveway. Those who will observe the occasional wide track made on our country roads will understand this result.

Towns and cities are no less affected by narrow tires than are rural districts, and it is little short of absurd that property owners should go to the expense of laying expensive pavements while those most benefited continue to destroy them with narrow tires. Coal carts, drays, tonnage and express wagons on narrow tires should soon become a thing of the past. The city of Ottawa has recently adopted a wide tire by-law, and this example it is to be hoped will soon be followed by others.

To understand the evil effects of narrow tires one has only to observe an empty, springless wagon jolting along the highway, or a loaded wagon ploughing its way through the crust of a gravel road in fall or spring. At all times narrow tires on wagons of heavy draught are the greatest destroyers of roadways. To get the most benefit from the statute labor and other road expenditure in the Province, to lessen the cost of roadmaking and maintenance, narrow tires must be discarded by those engaged in heavy teaming on our roads.

Broad tires, on the contrary, are in a way a benefit rather than a detriment to roads. Their broad surfaces perform the work of rollers in keeping a smooth and compact roadway free from ruts. Wide tires more than any other means that can be adopted, distribute wear over the surface of the road. Narrow tires do the work of a pick on a roadway, while broad tires do the work of a pounder. The one tears up, the other consolidates.

CULVERTS.

Small culverts should be made of vitrified or concrete tile, or iron pipe. Stone masonry is the best material for larger culverts. There is a tendency in some municipalities to narrow waterways across road allowances by the use of embankments. This practice while formerly adapted to the conditions of the climate in Ontario, have become very objectionable since the land has become cleared of its timber, and extensive drainage works have been constructed. Subjected as we are to severe floods and freshets unrestrained by timbered land and augumented by large drains, every facility should be offered to the flow of water. Large expenditures have been created by washouts caused by contracted waterways under bridges and culverts, an extravagant method of lessening the original cost.

BRIDGES.

Iron and steel are rapidly increasing in favor as bridge materials, replacing wood to a very great extent. The former are constantly decreasing in cost while the value of wood is increasing. There are, however, sections of the Province where wood is still plentiful and where, notwithstanding the greater durability of steel, economy dictates its use. The selection of any particular form of bridge must be controlled by the adaptability to location and economy since no one of the well-recognized types of bridges whether beam-truss, suspension-truss, or arch-truss is better than another. Any bridge designed on correct principles is good.

FENCES.

To provide a fence which will not cause snow to drift in the highway, completely obstructing it, and which will not on the other hand permit the roadway to be swept bare is a problem not yet solved. Where drifting is very common and such as to make the roads impassable, wire fences are the means generally adopted as a preventative. Several municipalities recognize this to such an extent that their councils provide the materials to all farmers who will erect wire fences along the highway. Wherever adopted, the plan is found to work satisfactorily.

ROAD MACHINERY.

In every branch of manufacture, industry and construction, the need of proper machinery is felt, and wherever it is used, the economy is recognized. Labor saving machinery as such, at one time received very much opposition but to day all invention and improvement is this regard is received eagerly.

The most important varieties of road machinery are rollers, which have already been described, graders and stone crushers. The last mentioned of these the stone-crushers, are almost indispensible in localities where gravel is not obtainable, and where field stone or bed rock are to be had. They are also valuable in localities where the gravel is coarse or where, while gravel is obtainable, macadam roads are needed and may be constructed from stone in the immediate vicinity. A screen attachment is very useful in coursing the metal and, in gravel, removing sand and earthy matter.

Graders are needed in every township and have about the same relation to roadwork that the self-binder has to the harvest field. Work can be done by them much better and more economically than by hand labor. A great portion of the successful use of a grader depends on the operator. He should be instructed in its proper management, should be capable of handling it in a workmanlike manner, and of following any instructions given him, and his services should always be employed when the machine is used. He should know also the proper way of shaping a roadbed since the machine of itself has no knowledge of roadmaking, and unless the operator has, satisfactory results can hardly be expected.

RESIDENTIAL STREETS OF TOWNS.

The principles of roadmaking which have been discussed, draining, rolling, metalling, etc., are all applicable to town and city streets, but in carrying them into effect they must be modified so as to add to the appearance of the finished roadway in a greater degree. The value of well-built roads in adding to the desirability of a town as a place of residence and thereby increasing the value of property, is greatly underestimated. So much is this the case that, while most country roads are not what they should be, the streets of towns and cities are very often much worse in proportion to the shorter road mileage and the ability of the citizens to pay for suitable pavements. In every town are to be found streets bordered on each side by handsome private residences and beautiful lawns, while the street between them is overgrown with weeds and at times almost impassable. To properly boulevard the streets, curb and macadamize the driveway, is not a costly undertaking, while the benefits in giving a park-like appearance to a street are of a nature not to be overlooked. Wherever street improvement is commenced it becomes very popular.

One of the first considerations is the width of the carriage way. The narrower this can be made, the better is the opportunity to have wide boulevards and handsome shade trees. An unnecessarily wide carriageway entails extra cost of construction and maintenance. A width of from twenty to twenty-six feet is found ample to accommodate the traffic of nearly all residential streets, even of the larger cities.

In forming the roadbed, it should be excavated to the required width to receive the metalling, and the excavated earth used in making boulevards or for filling in low lots to bring them to the grade of the street. The centre of the street should not be higher than the lawns on either side.

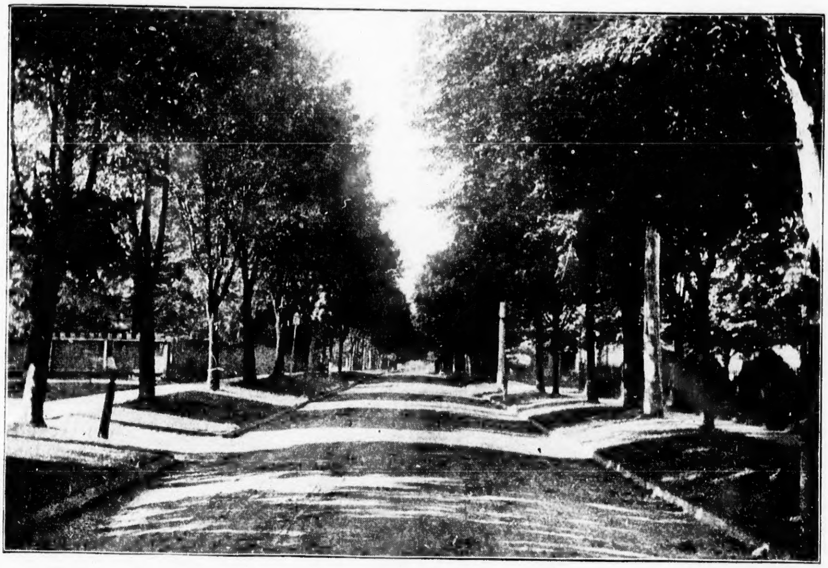
To confine the macadam in place and protect the boulevard and gutters it is advisable to place on each side of the roadbed a line of curbing. Where flagstone is easily obtainable it is the most durable curb, but a good substitute is three by ten inch cedar plank, spiked to six inch in diameter cedar posts. The posts should be two and a half feet in length placed in the ground at intervals of eight feet, and bevelled at the top so as to slope the curb slightly toward the boulevard.

In obtaining drainage, a line of common field tile should be laid under each gutter, below frost, and should be covered if possible with a porous material. The surface water may usually be led to the tile drains by catch basins placed where the grade of the road renders them most serviceable. If a system of sewers exists, it materially simplifies the question of obtaining outlets for surface and tile drains.

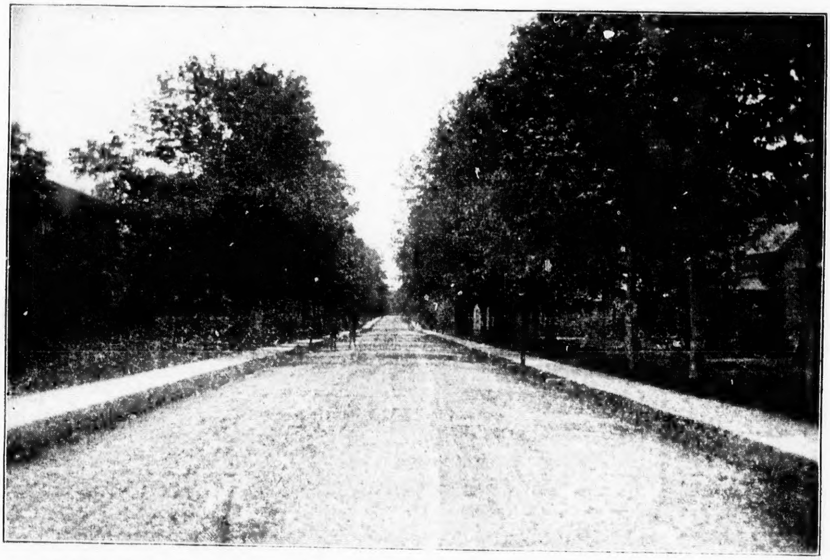
Grades should be reduced as far as practicable, having due regard to the draining of surface water and having regard to the elevation of the adjoining property. In fixing the grade it is rarely necessary to injure adjoining property by excess cuts or fills in front of it.

True economy in expenditure for street improvement is seldom understood in towns, and still more rarely is it put into practice. Streets are constructed and maintained by large amounts annually appropriated from the general funds, but these appropriations are subdivided and scattered over the street area in such small sums that the work performed, lacking the uniformity and unity so necessary to strong and durable results, is quickly absorbed by the mud. Fifty dollars is spent in an endeavor to cover water with gravel, with the result that the money is lost sight of within a year; whereas a proper amount spent in underdraining and carrying the water away would accomplish results that would be of benefit for a quarter century. And so examples of scattering the appropriations coupled with neglect of the laws of roadmaking might be multiplied to any extent. Temporary work is expensive, and councils should recognize this principle and secure as far as possible a concentration of expenditure.

A remedy which has been found of great service to many towns in obtaining permanent work on streets is the "Local Improvements By-law" whereby the residents on any street may petition the council for certain improvements. Money is raised by the issue of debentures, and the cost of the work assessed against the property benefited according to frontage, area, or assessed value. By this means sufficient money can be raised at a low rate of interest to do lasting, serviceable, and consequently economical work. The payments are small extending over a term of years, the value of property is at once enhanced, and the individual property owners as well as the town as a whole at once reap the benefit of the expenditure, while the ultimate outlay is no greater. Other benefits are numerous, but to bring the Act into operation in a town or city it must be sanctioned in the form of a by-law by a vote of the freeholders. In framing the by-law much care must be taken to make provision for peculiar local circumstances, and to this end its operation in other towns should be studied.



METCALF STREET, ST. THOMAS.—The roadway twenty-two feet wide and curbed with 3x10 cedar, is made with a five inch rough flake-stone foundation and covered with clean coursed gravel, seven inches in depth after being consolidated with a heavy roller. It was built in 1892, and the photograph taken May, 1896.



ELGIN STREET, ST. THOMAS.—The roadway twenty-six feet wide and curbed with 3x10 cedar, is made of crushed limestone, 12 inches in depth at the centre and 8 inches at the curb after being consolidated with a heavy roller. The sidewalks are of artificial stone, four feet wide. Elgin Street is a leading thoroughfare, constructed in 1894, the above photo being taken in May, 1896.

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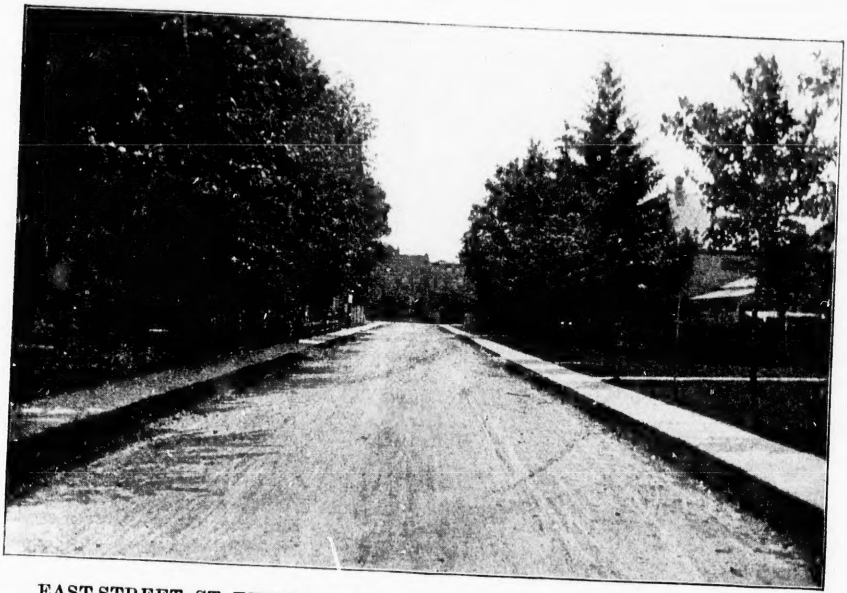
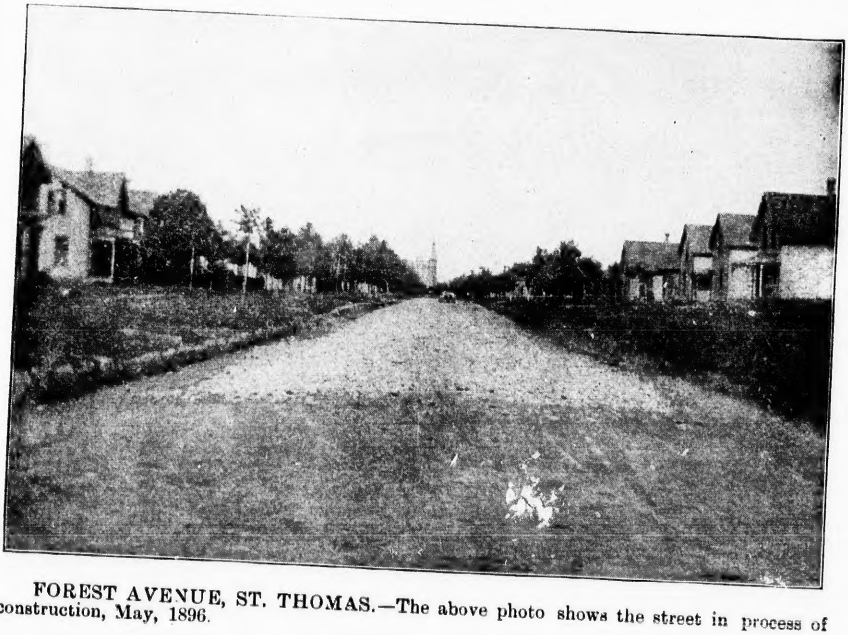


EAST STREET, ST. THOMAS.—The roadway is twenty-two feet wide, curbed with 3x10 cedar and made of crushed stone ten inches in depth at the centre and seven at the curb after consolidation with a heavy road roller. The sidewalks are four feet wide, of pine. The street was improved in 1895, and the above photograph taken May, 1896.



FOREST AVENUE, ST. THOMAS.—The above photo shows the street in process of construction, May, 1896.